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Journal of the Society of Arts.

FRIDAY, MAY 17, 1867.

Announcements by the Council.

Ordinary Meetings.

Wednesday Evenings at Eight o'Clock:—

MAY 22.—Derby-day. *No meeting.*

MAY 29.—"On the Water Supply of the Metropolis in relation to the Conservancy of the Thames and its tributaries, and the demands of the Water Companies." By J. BAILEY DENTON, Esq.

Cantor Lectures.

The concluding lecture of Mr. CHAFFERS' course, "On Pottery and Porcelain," will be delivered as follows:—

LECTURE VII.—MONDAY, MAY 20TH.

ENGLISH PORCELAIN.—Bow—Chelsea—Derby—Worcester—Liverpool—Wales—Plymouth—Bristol—Lowestoft—and other Manufactories—Battersea Enamel, &c.

The lecture commences at eight o'clock, and is open to members, each of whom has the privilege of introducing one friend.

Conversazione.

The Council have arranged for a Conversazione on Thursday evening, the 23rd May, at the South Kensington Museum, cards for which have been issued.

Artizans' Visits to Paris.

The Council of the Society of Arts, feeling the importance of promoting the intelligent study of the Paris Exhibition and the manufacturing establishments in France by artisans of the United Kingdom, have appointed a Committee in furtherance of this object. The following gentlemen constitute the Committee:—

Rt. Hon. C. B. Adderley, M.P.
C. W. Aitken.
Edward Akroyd, M.P., *Vice-Pres.*
Sir Wm. G. Armstrong, C.B.
A. S. Ayrton, M.P.
S. A. Beaumont.
John Bell, *Memb. of Council.*
Professor Bentley, *Memb. of Council.*
Lord Berners, *Vice-Pres.*
Hon. and Rev. S. Best.
D. Roberton Blaine, *Memb. of Council.*
W. H. Bodkin (Assistant-Judge), *Vice-Pres.*
Sir J. P. Boileau, Bart., *Vice-Pres.*
R. K. Bowley.
Antonio Brady.
Rt. Hon. H. A. Bruce, M.P.
Decimus Burton.
C. Buxton, M.P.
The Earl of Caithness, *Vice-Pres.*
Lord Eustace Cecil, M.P.
R. L. Chance.
Harry Chester, *Vice-Pres.*
The Masters of the City Companies.
Henry Cole, C.B., *Vice-Pres.*
Robt. Coningsby.
Rt. Hon. W. Cowper, M.P.
Sir Francis Crossley, Bart., M.P.
J. Bailey Denton, *Memb. of Council.*
Lord de l'Isle and Dudley, *Vice-Pres.*
The Duke of Devonshire.
Charles Dickens.
James Easton, *Memb. of Council.*
C. W. Eborall.
Lord Ebury.
Lord Elcho, M.P.
William Fairbairn, F.R.S.
Professor Fawcett, M.P.
Peter Graham, *Memb. of Council.*
The Earl Granville, K.G., F.R.S., *Vice-Pres.*
The Earl Grosvenor.
Mr. Hansard.
G. W. Hastings.
Wm. Hawes, F.G.S., *Vice-Pres.*
J. Pope Hennessy.
Sir Rowland Hill, K.C.B.
Chandos Wren Hoskyns, *Vice-Pres.*
T. Hughes, M.P.
Blanchard Jerrold.
Rev. C. Kingsley.
Hon. A. F. Kinnaird, M.P.
Lord Henry G. Lennox, M.P., *Vice-Pres.*
The Bishop of London.
The Sheriffs of London and Middlesex.
Rt. Hon. Robt. Lowe, M.P.
Lord Lyttelton, *Vice-Pres.*
Archbishop Manning.
Henry Maudslay, *Memb. of Council.*
Rev. F. D. Maurice.
The Lord Mayor.
J. Stuart Mill, M.P.
Rev. Dr. Miller.
The Bishop of Oxford.
J. Slaney Pakington, *Memb. of Council.*
Right Hon. Sir John S. Pakington, Bart., M.P., *Vice-Pres.*
Alderman Sir B. S. Phillips.
Sir Thomas Phillips, Q.C., F.G.S., *Vice-Pres., Chairman of the Council.*
The Duke of Richmond.
Rev. W. Rogers.
The Marquis of Salisbury, K.G., *Vice-Pres.*
Titus Salt.
Sir Francis Sandford, *Vice-Pres.*
Colonel Scott, R.E., *Memb. of Council.*
The Earl of Shaftesbury.
Benjamin Shaw, *Memb. of Council.*
Sir J. P. Kay Shuttleworth, Bart., *Vice-Pres.*
S. Smiles.
Seymour Teulon, *Treasurer.*
Thomas Twining, *Vice-Pres.*
Alderman Waterlow, *Memb. of Council.*
E. W. Watkin, M.P.
G. Watts.
George F. Wilson, F.R.S., *Memb. of Council.*
Vice-Chancellor Sir Wm. Page Wood, F.R.S., *Vice-Pres.*

The Council, on the recommendation of the Committee, have passed the following minute:—

At the last and former International Exhibitions held in this country, arrangements were made by the French Government, to facilitate the visits of skilled artizans, and interesting reports on the exhibitions were made by them to their government. Believing that such visits on the part of skilled workmen to these great international displays not only exercise a beneficial influence upon the men themselves, but also upon the progress of industry in the country to which they belong, the Council of the Society of Arts have resolved to raise a fund to be employed, in aiding a limited number of English workmen to proceed to Paris for the purpose of studying the present French Exhibition.

To carry this object into effect, they have agreed on the following plan:—

1st. That a number of selected workmen (the number to depend on the amount of funds at the disposal of the Council) shall be assisted to proceed to and remain in Paris a sufficient time (say three weeks), for the purpose of making a careful study of the exhibition, and of such factories and workshops as they may desire to visit.

2nd. That every man so assisted shall, on his return, make a report to the Society of what he has observed during his stay, in reference to the special industry in which he is engaged, and that it be made a condition of the grant to each man that one-third of the amount be retained until his report shall be supplied to the Society.

3rd. The Council think it will be undesirable to fix the exact time for, or to prescribe the duration of, these visits, or to interfere with any of the arrangements the men may desire to make for their own accommodation; but, in order that they may take advantage of the facilities provided by the Commission organised by the French Government for the study of the exhibition, the men will be placed in communication with that Commission on their arrival in Paris.

4th. A considerable sum will be required satisfactorily to accomplish the important object undertaken by the Society, and, in order to raise these funds, the Council have determined to appeal to the members of the Society, who must be interested in the successful results of this movement, in the belief that they will not hesitate to join in a subscription for the furtherance of the undertaking; and they propose at the same time to communicate with the various Chambers of Commerce, inviting their counsel and support. The Council have decided to commence the subscription by a vote of one hundred guineas from the funds of the Society.

Members are invited to aid the Council in this undertaking by subscriptions, which should be forwarded to the Financial Officer at the Society's house.

HARVESTING OF CORN IN WET WEATHER.

The Council of the Society of Arts have resolved to offer the Gold Medal of the Society, and a Prize of Fifty Guineas, for the best Essay on the Harvesting of Corn in Wet Seasons.

The first part of such essay—after noticing the various systems at present adopted in damp climates for counteracting the effects of moisture upon cut corn in the field, and for avoiding such exposure in wet seasons by peculiar harvesting processes—should furnish a practical and analytic exposition of the best available means:—

1st. Whereby cut corn may be protected from rain in the field.
2nd. Whereby standing corn may, in wet seasons, be cut and carried, for drying by artificial process.
3rd. Whereby corn so harvested may be dried by means of ventilation, hot air, or other methods; with suggestions for the storage both in the ear and after threshing.
4th. Whereby corn, sprouted, or otherwise injured, by wet, may be best treated for grinding or feeding purposes.

The whole to be supplemented by a statement of practical results, and actual cost of each system described; and authenticated estimates of any process proposed for adoption, based upon existing but incomplete experiments.

The above requisitions are given suggestively; not to bind the writer to the order or to limit the treatment of the subject, provided it be kept within the scope of practical experience and utility.

The essays must be sent in to the Secretary of the Society of Arts on or before the 1st of January, 1868.

The Council reserve the power to withhold the whole or part of the prize, in the event of no essay being, in the opinion of the judges, of sufficient merit.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

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FOOD COMMITTEE.

A meeting of the Sub-Committee on Meat was held on Wednesday, April 17th, at which there were present Mr. Benjamin Shaw (in the chair), Mr. J. Ware, Mr. Harry Chester, Professor J. Wilson, Mr. Ludford White, and Mr. E. Wilson.

Mr. HENRY GRAINGER, having attended upon the invitation of the Committee, stated he had been for many years engaged in the foreign provision trade in London and in Liverpool, and was three years since President of the Liverpool Chamber of Commerce.

The CHAIRMAN explained to Mr. Grainger that the object of the Committee was to inquire how far, and from what sources, the supplies of nutritious food for the labouring classes in this country could be increased and cheapened; and Dr. Edward Smith, having, in his book, "Practical Dietary," mentioned bacon, and particularly American bacon, as a valuable article of food, the Committee would be glad to hear whether, in Mr. Grainger's opinion, the importation of that commodity could be increased, and whether it could be made a good and useful article of food at a low rate?

Mr GRAINGER replied that the quantity could be increased indefinitely; but it was a question of price. As far as his own experience went—and that had been very extensive—he had never been able to get from any part of the world salt beef which the English people would eat at a low price. During the late American war, he said, when the Southern markets were closed, very large quantities of American bacon were exported to this country, at a first cost of threepence per pound. Since the close of the war the price had advanced considerably, the first cost wholesale being, in round figures, fivepence per pound by the hundredweight or ton. The quality of the bacon sometimes varies, but is tolerably uniform. The present price of American bacon was from 40s. to 50s. per cwt., according to the quality of the meat; the retail price would be from 6d. to 7d. per pound. English or Irish bacon was from 2d. to 3d. per pound dearer. American bacon is never considered to be of so good a quality for consumption in this country as English or Irish cured. One reason is, the Irish bacon, from the rapid means of conveyance, can be more mildly cured, whereas the American bacon, having to come a considerable distance, requires a stronger cure, and is very salt. The English people like things mild, and will not eat very salt meat of any kind. The Irish cured bacon is more adapted for our consumption, and the best qualities form an article of luxury on the breakfast-table. As far as he was aware, no attempt had been made to send meat from America without salt; he did not think it would answer, owing to the extreme fastidiousness of the people in respect of food. Although the very finest quality of salt beef was offered in establishments in various parts of the country at 3d. per pound it was a total failure; the miners and colliers would not eat it; that was meat which came from the United States, and of the primest quality, but highly salted, which prevented its sale. The salting went beyond the ordinary salting of meat in this country, but not beyond that which was supplied for cabin provisions of first-class ships. He believed the present supply of American beef in this country was not large, and such as was on hand was rather dear; the price of ship's beef varying from 4½d. to 6d. per pound, bought as ship's stores. Some of the meat was without bone; but, strange to say, preference was given to meat with bone for ship's use. He would be happy to send a piece of this description of beef for the inspection of the Committee, and it would be found to be of a quality of meat equal to anything that could be obtained in Leadenhall-market, and not more salt than the Committee would like for their own eating. In troop and emigrant ships they would find beef of very fine quality. He had seen specimens of the Australian cooked beef, which had lately been imported into this country, in cases hermetically sealed, but he very much doubted whether it would ever acquire a large consumption by the people here. Salted meat in the raw state from Australia and South America, was at one time sent over in large quantities, but it was a perfect drug in the market. Such provisions were very rarely purchased by the public. At the principal places of preparation of such meat—beef and pork—as he (Mr. Grainger) had spoken of, it would pay the people to produce the raw article in the Western States of America to sell it at 2d. per lb., but of late years they have obtained a higher price than that both for beef and pork; but it could be produced there at 2d. per pound. A half-penny per pound would cover the expense of carriage from the Western States to the seaboard, while the cost of the sea passage and charges would be equal to another half-penny per pound. The quantity of bacon was larger last year than in the previous one, though it was nothing like the maximum during the American war. He believed the quantity could be increased indefinitely if there were the means of paying for it. For his own part, he decidedly preferred, for his own eating, pork fed in England or Ireland, from the fact that the American pork was, to a large extent, fed upon Indian corn, which made a rich meat, with a great tendency, from its richness, to turn rancid, when prepared as bacon. The over-greasiness of the American bacon was one objection to its use in this country; the want of firmness in the meat he attriduted in a great measure to the way in which the hogs were fed. After "priming" in the woods, they were turned into the maize-fields, where they got a second feeding, and the result was one portion of the fat was hard and the other soft. With the corn-fed hogs, the whole of the fat would be firm, and a proper firmness of the meat was a test of its quality. The fat should be firm to the touch and the lean tender.

The Chairman asked Mr. Grainger whether he looked to future large importations of either meats?

Mr. Grainger replied there were very large cattle raisers, and large quantities of salt meat were now shipped to this country. The great centres of the trade were Cincinnati and Chicago, the latter having taken the lead. About three-fourths of the exports were consigned to Liverpool, and one-fourth to London, but a great deal was sent by railway from Liverpool to London, so that the relative consumption of the two districts could not be estimated on that account. He thought the amount of curing that was sufficient to preserve English and Irish bacon would be sufficient to preserve the American bacon during the short time that was necessary for its transit from the Western States to this country, but not for keeping during the time it had to be held for distribution in this country. The curing for two or three months produced the supply for twelvemonths, and mild cured bacon would not keep good for that time. The Irish bacon was not thoroughly cured, but thoroughly cured bacon would keep for any length of time without becoming tainted. Large quantities of pork were sent from America, as barrelled pork, in wet pickle, which was very good indeed, and met with a ready sale. He saw some of this description of pork the day before, the price of which wholesale was 5d. per pound. It was frequently sold by the retailers. It was not so salt generally as the American bacon; only moderately salt. There were other large markets for American meat besides our own; and very low prices in this country would be prohibitory to its importation, whilst better prices could be obtained elsewhere. If we were willing to give good prices there is no limit to the quantity they could send. Large quantities of bacon are imported from the north of Europe, from Denmark, Holstein, and Hamburgh, which in quality compares favourably with English and Irish, and the difference in price is only about a half-penny per pound. The price was the great criterion of quality.

The Chairman asked Mr. Grainger whether he agreed with the following passage in Dr. Smith's book on "Practical Dietary," with regard to American bacon:—"The economy of bacon depends upon the price which is given for it. Thus, when 9d. per lb. is paid as a medium price for English or Irish dried bacon, the amount of nutriment which can be obtained for 1d. is only 530 grains of carbon and 11 grains of nitrogen; but American bacon, in a somewhat less dried state, is sold at 3½d. and 4d. per lb., and at the latter price would offer 1,070 grains of carbon and 20 grains of nitrogen. The flavour of the latter is seldom so good as that of the former, since in the western parts of America the hog is chiefly fed upon acorns, hickory nuts, and other seeds called 'mast,' in the woods, and the curing is seldom so carefully performed as in this country; but when a fair sample of it is procured it is an agreeable food, and is far more economical than the English or the Irish bacon. From the imperfect feeding of the American pig, a large proportion of the fat runs out of the bacon when it is boiled, and the piece shrinks in size, so that the housewife cannot cut so many slices from a given weight; but if the liquor is made useful as food this is only an apparent and not a real disadvantage. There is at least five per cent more water in American than in well-cured English bacon."

Mr. Grainger remarked that the method of feeding above described was formerly adopted, but had been to a great extent discontinued, as the people would not eat the acorn and mast-fed pork, and it was no longer imported into this country. If it were it would be unsaleable. To show the truth of Dr. Smith's observation, it is the fact that the Irish producers ship all their superior qualities of bacon to our markets, and import largely American bacon from Liverpool for home consumption. They did not mind its being a little greasy; what we regarded as the impurity of the article appeared to be a recommendation with them in the way they use it. They preferred giving 1d. per lb. less for American bacon, and shipping their own produce to England and getting a higher price for it. The Irish people are large consumers of American bacon. At the present time there was a better system both of feeding and curing pigs in America than formerly, and there was no fault to be found with either. Still, the American bacon was inferior to both English and Irish. The American pigs were more quickly fattened, and consequently became rancid by keeping. One would eat a portion of American bacon, and pronounce it good, but would not ask for more. There was no particular fault to be found with it in the eating, but it was not appetising.

Professor Wilson said during his visit to America he made it his business to inquire into the method of feeding and curing pigs in that country, and he found that the great bulk of the animals were fattened upon Indian corn. On the western prairies, where the soil would not grow wheat, Indian corn was cultivated in large tracts, and it was grown there to an extent that could hardly be conceived. He had seen maize crops from 12 to 14 feet in height. It was so for many miles. The farmers could not send it as corn to the market, and they turned hogs into these corn tracks by hundreds and thousands, and thus they carried the Indian corn to market in the shape of pork. That was what they called "condensing" it as pork. The hogs when fatted were sent to the large killing and curing establishments at Ohio, Indiana, and Terre Haute, to be made into bacon, and dried for home consumption. This pork was all of superior quality, being fed upon Indian corn. No better food could be given to the animals than the Indian corn, mixed with the juicy and sweet stems of the corn; but the pork was considered to be too rich for the

English palate. Pigs fed on potatoes and meal fatten slower; the fat is firmer, and the meat nicer eating. Some of the hogs were brought to as much as 200 lbs. weight. The factories were several stories in height. The pigs were driven up an inclined plane to the top floor. They were then placed together in rows, and then two men ran along on the backs of the pigs, with little pole-axes, and hit them on the head like playing musical-glasses. In this way they were taken to the top as live pigs, and, passing through successive stages, reached the bottom as cured pork, ready for drying as bacon. The system had altogether been brought to very great perfection.

Mr. Grainger observed, with regard to beef from South America and Australia, various attempts had been made to salt it and send it to our markets. The cattle were in the best condition for slaughtering, at a time of the year when the temperature of the climate was too high to admit of mild salting or pickling. If they deferred the salting till the winter time the meat would be in such a thin and lean condition that it would not be acceptable in this country, and thousands of packages have been sold here for less than the value of the casks. It might naturally be supposed that they could prepare that beef and send it over in great quantities; but owing to the climate, at the time the meat is in best condition, it could not be cured in the usual way. This remark applied equally to South American and to Australian beef. He had seen meat salted by the injection process of Dr. Morgan. That process had been partially successful; so much so that what was formerly sold at a guinea per tierce, from the peculiar state of the market, rose to 85s. per tierce, or about 3d. per pound. That was pickled in salt. Some of the beef and mutton sent from Australia had been sold here. The cooked canister beef prepared by Tindal's process he did not think would ever become of large or general consumption in this country by the lower classes. It would no doubt be used to a certain extent; as a little change from salt provisions it would be agreeable. He believed it had been found out that in these tins certain gases are generated, which produced dysentery when used to any large extent; and therefore it would not do to introduce it largely into the commissariat of an army. This remark, he believed, applied more or less to all meat preserved in tins. It was not, in fact, wholesome as a general article of diet. That was what he had heard. It might be used as an occasional change of diet, but should not be make a frequent article of food. The effects were seen in the provisioning of the troops in the Crimea. He believed there was a little selling now. All attempts of this kind had been failures, partly because when a tin was opened it required to be used immediately, and if kept it became spoilt. The Government were now preparing largely for themselves provisions for the navy, although it was done at an expense considerably above what the same class of provisions might be bought at, with the pick of the market.

Mr. Ludford White said he could contradict from personal experience the statement that the preserved meat would not keep when the tin was opened. He had kept the meat good for a week in an ordinary larder.

Mr. Grainger believed, if it could be sold at the counter at 6d. per pound, there would be a demand for it. It was astonishing what a difference a penny per pound in bacon made in the consumption. American bacon, to meet with a sale in this country must be put on the counter at 6d. per pound. At the present time they could not dispose of any large quantity of American bacon at 7d. or 8d. per pound. If it could be sold retail at 6d. per pound he had no doubt four times the quantity would be sold. It made a difference of 300 per cent. in the consumption. It was easy for a person with technical knowledge to distinguish between cooked English and American bacon. He would not like the latter so well as the former. It was not prejudice, but there was that real difference which would lead to preference for the one over the other. The best English and Irish bacon was at the present time 8d. per pound wholesale, and the retail price 10d. The only way to increase the consumption would be to increase the wages of the working classes, so that they might have the means of purchasing a fair proportion of the home as well as foreign produced meat. It was merely a question of price. If the price could be paid we might have meat from all parts of the world. In the words of the Americans, they could send us enough meat to sink our little island entirely. Probably as much meat might be sent from the banks of the Danube as from those of the Mississippi, but the cost of transit was a bar to the large exportation of it to this country.

Mr. Chester inquired whether any importations of pork were received from Spain?

Mr. Grainger replied it was rarely the case; there had been beef sent from Spain, but the price was high.

Mr. E. Wilson inquired whether any large supplies of beef had been received from Denmark?

Mr. Grainger replied very little direct. It was mostly sent to Hamburgh, and thence to this country.

The Chairman asked whether the same difficulty with regard to climate, which had been mentioned, existed with regard to Buenos Ayres?

Mr. Grainger believed it did. A company was formed in Monte Video for the preparation of meat, with some promise of success. He apprehended that a modification of Morgan's process might answer. He had seen a great many tierces of it. There seemed a probability of making a perfectly cured article. The meat was by no means so salt as that termed "junk," and a good price was given for it. Up to the present time it was liable to suffer injury in crossing the line, and required to be put in proper order before it was used. He referred to Queensland. It was obvious the cattle would be in the best condition when there was most grass for them to eat. There were no stall-fattened cattle there, consequently they were fattest when there was abundance of grass, and that would be in the early part of the summer, when it was too hot for curing in the usual way.

Professor Wilson said but for the difficulties of transit no doubt we could obtain any amount of provisions from the Lower Danube. There was an attempt made at it last year. Two fat oxen were slaughtered at Vienna, and sent express to London. The meat arrived within 50 hours after it was killed, and a joint was soon after put down to the fire to roast. The price obtained was 6¼d. per lb. Seeing that meat was selling here at 10d. per lb. it was an inducement to try the experiment. If it answered they could send a hundred or two of fat cattle per week.

Mr. Grainger said the largest importation of American bacon was 500,000 boxes, of 400lbs. each. That was in the second year of the American War. Last year it amounted to only about 70,000 boxes. The quantity had been much less since the end of the American War. In reply to questions put by Mr. Wilson, with regard to the relative price of English and American cured hams, Mr. Grainger stated that there was a more marked difference in the price of hams in favour of the former; American hams were for the most part unsaleable in this country. The legs sold better as wet pickled, but when they became hard, as hams, the people would not eat them. In fact it must still be borne in mind that the whole curing for the year must be done in two or three months, while the consumption extended over the whole year. He had remarked that the trade in American bacon began with a relish and ended with a nausea. He had seen fresh American hams almost as good as English.

Mr. Chester asked whether there was not a great increase in the importation of American cheese?

Mr. Grainger replied, the increase was very great indeed, and the prices had risen, in consequence of the improvement in the quality and in the manufacture that had lately taken place. The difference was only 2d. per lb. between the finest American and the finest

English cheese. The average quality was now very nearly equal to that of Cheddar. This was mainly due to the improved manipulation of the cheese, and Mr. Grainger explained that the plan had recently been adopted of establishing a cheese-factory for a whole district, instead of each person making his own cheese. The arrangements for the purpose were of the most perfect description, and by that means an uniform quality of cheese was obtained, instead of great variety of quality according to the individual methods of manufacture adopted. Each farmer delivered his quantity of milk at the factory every day, of which a record was kept. The factory was superintended by a man of practical knowledge and ability, and the result was American cheese had become, from its greatly improved quality, a very favourite article in this country. The demand for it was increasing, and the price had risen to nearly double what it was a few years ago. This system of manufacture had been adopted in most of the dairy districts of the American states. There were large factories of this kind in the State of New York and in Ohio. In a country where skilled labour was scarce, the mechanical appliances and methodical system of manufacture such as he had mentioned were evidently of the greatest advantage. The bulk of cheese was sold at the end of the season, and a *pro rata* division of the proceeds was made according to the quantity of milk sent in by each person. He believed the American cheese would have a very sensible effect upon the home manufacture, as the public would not select cheese below the quality of the best American. The American article had now established itself side by side with other articles in the provision markets of the country. Some of the cheese was made in English-shaped moulds; but American cheese was always distinguished by being wrapped in coarse canvas. Some cheese had been received from Sweden; that was not wrapped in cloth like the American, and he had sold some of it as high as 78s. per cwt., which was about 4s. above the price of American. It compared favourably with the best Cheddars. The importation of provisions from Canada was considerable, consisting of beef, pork, cheese, and a large quantity of butter. There were no climatic difficulties to contend against, as was the case in tropical latitudes. The resources of that country were rapidly developing. The head quarters of the export trade were Toronto, Hamilton, and Montreal. The transit had been the hindrance to larger exportations. Nothing was exported to this country from French Canada, and Newfoundland was a large importer of provisions from us and other countries. There was great hope from the development of the provision trade in Canada, as the articles were of a character which suited our markets. Self-interest, however, would lead them to produce an article that would suit our markets as nearly as possible, and there was every encouragement to improve the quality. They were quite aware of the necessity of salting as little as possible. Self-interest teaches people all these things. The love of making money is a greater stimulus than could be given by the action of this or any other committee; and looking to that they naturally made themselves acquainted with the best mode in which things are to be done; and it was not to be imagined that they were deficient in chemical as well as practical knowledge on these subjects.

The Chairman asked if there had been any attempt to preserve provisions from Canada otherwise than by salting?

Mr. Grainger was not aware of any; it would hardly pay them, he thought, to do so. In the matter of fresh preserved provisions it was entirely a matter of confidence in the manufacturers; and in the provisioning of a ship with such stores confidence in the article was of the greatest importance; and people preferred paying a higher price for that in which they had confidence rather than trusting to that which was cheaper. If a method of preserving provisions in a fresh state were discovered, as compared with salted meat, it would be a question of relative price. The government used formerly to enter into contracts for the supply of meat for the navy, but latterly they had been induced to cure the meat for themselves. He thought this would, before long, be found to be a mistake; looking to the fact that a large quantity must be spoilt. The reason alleged for taking that course was that they could not depend upon the quality of the provisions supplied by the contractors, and they must take care that the soldiers and the sailors were well fed. He believed the present system involved double the cost, and that no better article was secured than would be the case under the contract system, under which the most rigid inspection was instituted.

Mr. Wilson asked whether, from Mr. Grainger's experience, there was a possibility of preserving meat for a long time without so charging it with salt as to cause it eventually to assume the character of "junk."

Mr. Grainger considered it must necessarily be over salted. In some cases, according to climate, the meat might be more mildly cured, perhaps, than it was, but that would render rapid consumption necessary. He thought Morgan's process gave promise of success; if they could effect in a few days a salting which required several weeks under the ordinary processes, it must be considered an advantage. In the curing of Irish bacon in the hot weather, the temperature of the curing-house was artificially cooled. In reply to further questions on the subject of Irish cured provisions, Mr. Grainger stated his opinion that Ireland could never enter into competition with America in the article of beef, even if it were sent to this country in a very slightly salted condition; the price obtainable for fresh meat would be a bar to such a competition; and from the injury which cattle were said to receive on the passage from Ireland, it was better, perhaps, to bring the meat over dead. The steam communication from Milford offered considerable facilities for the carcase meat trade with Ireland. No doubt the risks of injury to live-stock were considerable, sea and land passage having to be encountered. With the increased means of transit that were being developed at the present time, no doubt other sources of supply of meat to this country would be opened out. If Hungary had a railway system it would be capable of sending considerable quantities of meat to England, but they wanted the means of transit, and the cost by railway would probably not be more than ten per cent. The salt-beef trade from Ireland might be considered as extinguished. The live-meat market was open to them, and the prices were very much assimilated to those here. The agencies already at work were, in his opinion, sufficient to produce the most economical results that could be desired; and he thought there was no room for anything further to be done in that direction. The powerful agency of self-interest was at work amongst producers as well as consumers. He did not think it was possible to suggest anything that was practicable beyond what had been done already. In reply to further questions with regard to the adulteration of butter, Mr. Grainger expressed his opinion that no foreign substances were introduced into the butter sold in London and elsewhere, and the only adulteration was that of the salt pickle, which gave weight to the article and added to the profits of the producer, but that had been carried in some cases to an extent which defeated itself.

Cantor Lectures.

"On Pottery and Porcelain." By W. Chaffers, Esq.

Lecture VI.—Monday, May 13.

English Pottery.

Mr. Chaffers commenced his sixth lecture by alluding to the drinking vessels which were in use in England previously to the 16th century. They were of a very coarse description, rudely fashioned, and usually devoid of ornament, but occasionally covered with a yellow or green glaze, and sometimes cast in a mould in grotesque forms. Numerous specimens of early English cups are found in the excavations made in the metropolis for the construction of sewers and large buildings, which may be, in many instances, identified by comparing them with the vessels depicted in mediæval manuscripts. But many other materials were used at the same period, and fashioned into drinking cups. The mether, a vessel made of wood, is frequently found in the bogs of Ireland, and, being of a square form, required some dexterity in drinking from without spilling its contents. In England the Peg tankard was much used in convivial parties. It was so called from a number of small pegs placed at equal distances to regulate the quantity to be taken by each person; these were frequently handsomely carved with religious subjects. Another description was the mazer bowl, so called from the German word *mæser*, signifying maple. Leather bottles, Venetian glass, cocoa-nuts, and other vessels constructed of a hard rind or shell, frequently mounted in silver, were also used. For plates and dishes a harder and more durable material was required, and wooden trenchers or pewter platters were generally in use. The vessels made in England were badly burned and not very durable, so that the German stone ware with a salt glaze was in general use throughout the 16th century, and was imported in large quantities. These stone pots were usually impressed in front with the arms of some German town, or other device, as a rose, &c., and under the spout was a ferocious bearded visage. They were derisively called "Bellarmines," after the celebrated Cardinal Bellarmine, who, in the 16th century, made himself so conspicuous by his zealous opposition to the reformed religion. It was not till the 17th century that stone ware pots were made in England of sufficient strength and cheapness to compete with those of Germany. In 1626 two Englishmen, named Rous and Cullyn, obtained the first patent for making stone pots and jugs, but, from their inferiority, the demand was not very great for them. The most successful imitation of the Grès de Cologne was made by John Dwight, of Fulham, which, in course of time, almost wholly superseded the importation of it from Germany. The Fulham stone-ware is frequently seen at the present day in collections; it is of exceedingly hard and close texture, ornamented with a blue or morone enamel in leaves and flowers, having in front medallions of the Kings and Queens of England, or their initials only. Mr. Chaffers alluded to a very interesting collection of specimens of the pottery made at Fulham, which were obtained by Mr. Baylis, of Prior's Bank, from a descendant of the Dwight family. Among these are some beautifully-modelled busts of Charles II. and James II., full-length figures of heathen deities, and various other objects, which show the perfection to which the manufacture had arrived. Dwight's first patent is dated 1671; at its expiration it was renewed for fourteen years longer. The next important pottery in England was at Lambeth, established about 1650, for the manufacture of Delft ware. The trade flourished here for more than a century, until about 1780, when the Staffordshire potters, by the great improvements they had made in the quality of their ware, and its cheapness, completely beat the Lambeth potters out of the field. Mr. Chaffers next passed in review the manufactures of Yorkshire. That of William Wedgwood, at Yearsley, about the year 1700, was the earliest of which we have any record, but a century later the well-known Leeds ware was made by Messrs. Hartley, Greens and Co. It is of a cream-coloured glaze, with much perforated or basket work sharply cut round the borders. The other manufactories were at Castleford and Rotherham, but the most important was that at Swinton, under the patronage of the Marquis of Rockingham, established in 1757. The well-known Rockingham teapot, of a chocolate colour, lined with white, had a great sale; but ornamental ware of a more artistic character was also made. Early in the 18th century Liverpool was the great centre for the manufacture of pottery, and in the first half of the century both fayence and porcelain were extensively made, both for home consumption and for exportation to the American colonies. About this time there was a large demand for punch bowls, and as these formed the principal ornaments on the side-boards of the middle classes, and especially on board the ships which were constantly going and coming in the port, considerable pains were bestowed in decorating them, and many are still preserved, painted with ships, convivial mottoes and inscriptions, flowers, &c. The principal potters were Alderman Shaw, Mr. Richard Chaffers, and Messrs. Sadler and Green, the inventors of the method of transferring prints from copper-plates upon pottery, perfected in 1756, and of which Wedgwood, as well as many other potters, availed themselves to decorate their wares. Towards the end of the 18th century the trade gradually left the town, not being able to compete with Staffordshire in the prices, and only one establishment of any importance survived, viz., that called Herculaneum. Swansea was next noticed, established in 1750, its most flourishing period being in 1780, while under the management of Mr. George Haines; it was continued by Mr. Dillwyn. Some of the earlier ware is very elegant in form and of a deep-blue glaze, and is what was termed opaque porcelain, carefully painted with birds and flowers. The lecturer then alluded to the rude and coarsely-painted ware made in Staffordshire previously to the year 1700, the ornaments being merely coloured clays, diluted and trailed over the surface through a quill; these colours were orange, white, and red, and glazed by means of lead ore beaten into dust and finely sifted and strewed over the surface. The vessels remained 24 hours in the kiln, and were sold principally to poor cratemen, who carried them at their backs all over the country for sale. The forms were dishes, tygs, or mugs with two or more handles for passing round a table, candlesticks, &c. The potter to whom Staffordshire owed great improvements in the manufacture of earthenware was John Philip Elers, from Holland, who, being a clever chemist, discovered the art of mixing the clays of the neighbourhood to great perfection. His imitations of the red ware of Japan, with leaves and other ornaments in relief, are well known. The various manufactories at Burslem, Bradwell, Shelton, Tunstall, and other places in "the potteries," and the gradual improvements in the composition and glazing of the ware, were adverted to in turn, illustrated by specimens which had been procured for the occasion, including the Staffordshire agate, marbled, tortoise-shell, cabbage-leaf tea services, &c., made by Wheildon; the moulded ware of Enoch Wood; the close imitations of Wedgwood's jasper made by Turner, Adams, Neale, and others. The family of Wedgwood was of long standing at Burslem, and many members of it were engaged in making pottery long before the birth of the great potter, Josiah Wedgwood, which took place in 1730. He was the youngest of 13 children, his father dying when he was only nine years old; his eldest brother succeeded him, and took Josiah as an apprentice in 1744. During his apprenticeship he was seized with a violent attack of small pox, which left its effects in his system and settled in his leg, and an accidental bruise resulted in the amputation of his leg in the 34th year of his age. In 1754 he went into partnership with Thomas Wheildon, and he remained at Fenton for five years, after which he returned to Burslem and commenced business on his own account. Here he set himself earnestly to work, improving day by day in everything he undertook, and became so successful that he was compelled to enlarge his works, and he engaged the services of his cousin, Thomas Wedgwood, who in a few years became his partner in the "useful branch," especially the Queen's ware; in 1768 he took into partnership

Thomas Bentley, to whom was entrusted the "ornamental branch," both departments being kept distinct as far as the interests of his partners were concerned. In 1769 he opened a very extensive manufactory, which he called Etruria, and his first productions were copies of Etruscan vases, for which he took out a patent. In 1773 he made a fine white terra cotta, proper for cameos, portraits, and bas reliefs. In 1776 the solid jasper ware was invented, in which Wedgwood largely employed sulphate of barytes, and for many years derived great profits from this, none of the workmen having any idea of the nature of the material upon which they were operating, until a letter containing a bill of parcels of a quantity of this article fell into the hands of a dishonest servant, who told the secret, and deprived the inventor of that particular source of emolument; for when the same article was made by those who employed inferior workmen, to whom they gave only one-fourth of the salary given by Wedgwood, the price became so reduced that he was unable to employ the exquisite modellers he had previously engaged. In 1780 his partner Bentley died, and the superintendence of the ornamental branch was given to Webber, a clever modeller, who, among other works, copied the celebrated Portland vase. Flaxman was engaged by Wedgwood and Bentley as early as 1775, and he continued furnishing them with designs and models up to the time of his departure for Rome in 1787, but after that he occasionally executed some models, and overlooked and gave finishing touches to the works of the Italian artists who were employed in copying subjects from the antique for Wedgwood at Rome. Josiah Wedgwood died on 3rd January, 1795. Some fine examples of Wedgwood's bas-reliefs in black basaltes and in jasper were exhibited. In conclusion, Mr. Chaffers remarked that the great improvements effected by Wedgwood may be best judged by a comparison with the works of the potters who immediately preceded him, many of which were on the table. Wedgwood not only in his "useful branch" displayed his aptitude for combining utility with neatness, and a certain degree of elegance, but in his "ornamental branch" he had a higher aim, which was to emulate the ancient potters of Greece, and in this he was ably assisted by his partner, Thomas Bentley. The lecturer referred his hearers who desired to be more fully informed upon the subject to the interesting work, "The Life and Works of Josiah Wedgwood," by Eliza Meteyard. The authoress had endeavoured to do all honour to his illustrious name, and with the materials she had gleaned from various sources (especially the manuscripts in Mr. Mayer's possession) had, with untiring energy and zeal, fulfilledthe task of a faithful biographer.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 15th, 1867; W. H. DALTON, Esq., in the Chair.

The following candidates were proposed for election as members of the Society:—

Armit, Lieut.-Col. Louis, R.E., Golden Cross Hotel, Charing-cross, S.W.
Lucas, Frederick, 26, Maddox-street, Regent-street, W.
Salvin, Anthony, 4, Adam-street, Adelphi, W.C.
Whitley, Nicholas, Truro, Cornwall.
Williams, Michael, 35, St. James's-place, St. James's-street, S.W.

The following candidate was balloted for, and duly elected a member of the Society:

Whichelo, George, 14, Burnley-road, Stockwell, S.

The Paper read was—

ON NEW MACHINERY FOR CUTTING, TUNNELLING, QUARRYING, AND FACING SLATE, STONE, AND MARBLES.

By W. FOTHERGILL COOKE, Esq.

> "Coctilibus muris cinxisse Semiramis urbem."
> Semiramis is said to have surrounded the city with burnt-brick walls.

Such was the defensive material for fortifications in the days of Semiramis; and the grand old temples and palaces of Nineveh, thinly coated with richly sculptured slabs of limestone, or precious marbles over bricks (burnt or unburnt), stood forth with well-contrasted grandeur and apparent solidity. The Romans and the Lugdinenses of their day, conjointly reversed the practice; and whilst the Roman general fortified the city with stone ramparts, the London citizens raised their habitations in fiery red bricks.

Stone is scarce, whilst clay is still abundant in the precincts of London; and sea-borne coal cheaply converts the subsoil into the most handy of building materials. Not only is stone scarce, and expensive in the rough block, but the finished and ornamental working of it is most costly, and even a thin casing of stone adds from fifty to seventy-five per cent. to the architect's estimate for a frontage alone.

I trust this evening to introduce to my hearers some novelties in the machinery for cutting rock, and working stone for ornamental purposes, which may encourage our architects and builders to adopt stone, instead of London brick and Roman cement, in their future elevations, and thus open up a prospect of a better architectural future for at least our western streets and mansions.

Stone, of good building qualities and easily worked, is abundant in many parts of Great Britain; and the charges of carriage by canal, rail, and sea would not materially affect its use in the better class of buildings, if it could be worked more economically, and sent up in a quite, or nearly finished state from the quarry.

A class of stone rarely or never seen, I believe, in London buildings, but much used in the best buildings in North Wales and some parts of England, the tertiary limestone, is very durable and cheap, and takes an excellent face, almost approaching to a polish, under the new tool. Sandstones, Portland, Caen, and Bath stone, are all much softer and mostly less durable than limestone, but not more easily worked.

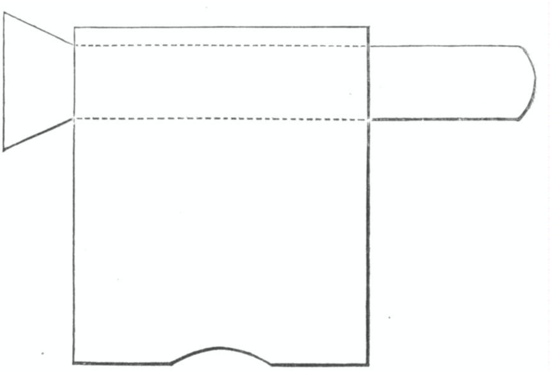
Machinery, which has been so widely applied to other trades, has hitherto done but little for masonry, though in this remark I confine myself to masonry proper, not including sculpturing by machinery. Except by the sand-saw, and occasionally by the circular toothed-saw, stone has hitherto been worked chiefly by hand. I wish here to remark that the harder stones, including the granites and granite-like rocks, cannot be operated upon by this machinery at all. This machinery, which I will now proceed to describe, depends chiefly for its efficacy on the peculiar forms of the cutting tools or movable teeth; firstly, in the application of them as attached to holders or sockets fixed in the edges of the blade, instead of the blade itself forming the cutting edge; and secondly, as applied to the circumference of cylinders for surfacing. The tools, or cutting-teeth, are, in consequence of their being movable in the sockets, easily replaced as required without any reduction of the diameter of the blade, which so soon renders the circular saw, when applied to the cutting of stone or slate, useless. These movable tools or teeth are capable of application to machinery for a variety of purposes, firstly, to the sawing of blocks and slabs of rock of considerable thickness, for building or other purposes; secondly, for facing the surface of squared-up stones in an ornamental manner; thirdly, for tunnelling, for undercutting stone, slate, or coal in situ, where the rock lies more or less on the incline, and also for the vertical cutting of the living rock almost as readily as a haycutter cuts hay out of a stack. These movable tools, held in movable sockets, are, as I have said, the distinctive features of this machinery, and they are exclusively the invention of Mr. George Hunter (now of Maentwrog, North Wales).

"Hunter's saws," with the improvements which have rendered them so effective for many purposes, are becoming well-known in the United Kingdom. They are extensively used in North Wales; and last autumn Mr. Hunter put up one at South Shields, for the Commissioners of the Tyne Navigation. The diameter of the blades in this saw is seven feet, and it carries two blades on the axle. It is employed to cut the limestone of the neighbourhood for the Harbour works. The performance of this saw gave such satisfaction that a second was speedily ordered, to carry two blades of thirteen feet diameter each. This gigantic machine is now finished, and will be speedily at work upon the same limestone. Its depth of cut is over five feet. As there is no reason why the thirteen feet saw should not work as easily as those of seven feet, the success of this machine will, I feel confident, attract the attention of engineers and contractors to the desirability of this means of squaring large stones for harbour and similar purposes, where size, economy, and time, are always of leading importance.

As it is known to many now present that my own name is united with Mr. Hunter's in several recent patents, I will observe that my share has chiefly consisted in extending the application of the movable tools and tool-holders (the real essence of his invention) to fresh and wider fields of usefulness, whilst the onus of adapting the machinery to each novel application, and in so doing producing an entirely new result, has fallen upon the inventive genius and mechanical skill of Mr. George Hunter.

Fig. 1 represents the movable cutting tool, now most in use, fixed in its holder or socket. It is a bolt made of the best rod steel; the head is forged into a cupped or trumpet form—turned, and then hardened. When in use it is simply slipped into its socket, which is also made of steel, and wedged tight by a piece of paper or a thin shaving of wood. When the edge is dulled or chipped the tool is turned in its socket so as to offer a fresh cutting margin: and, as it wears away chiefly on the advancing side, the tool will generally offer three, sometimes four fresh surfaces before it is worn out. These tools, according to the circumference of the saw blade, are from four to eight inches long, and the cutting head itself from half an inch to one and a quarter inch wide. The length of the bolt allows of the tool being softened, again set up, turned, and hardened, until it is too short for further use.

FIG. 1.



The stems of the sockets are of the same thickness as the blades that receive them, and are slipped into grooved openings in the margin of the blades, to which they are fitted with accuracy by machinery. As the blades revolve slowly, the tools are usually replaced, or merely turned round in their sockets when necessary, without stopping the machine, and should thus be kept

FIG. 2.

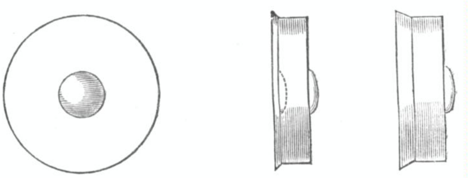
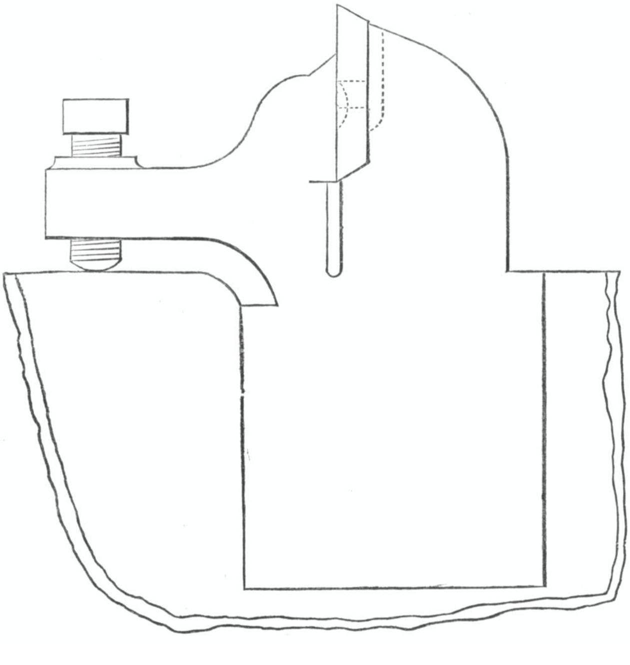


FIG. 3.

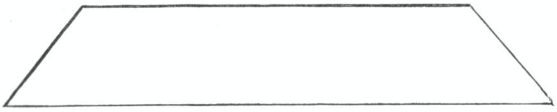


always in good cutting order. The cupping, shaping, and tempering of these tools require modification in each case, to adapt them to the texture of different kinds of stone. Limestone and sandstone, for example, cut away in large chips, whilst slate has to be scraped away, and the tool must be made to suit each case.

The next tool (see Fig. 2) to which I will direct your attention is formed by the double action of a punch. The first action cuts out a round disc from a plate of steel, like the punching of a boiler plate; the second action converts the disc into a tool, precisely similar to the head of the bolt-like tool just described, only ready cupped and sharpened, with a boss behind, to fit into a corresponding groove in the back of its holder, and with a hollow in front for a nipping bolt, or pinching screw, to grip it (see Fig. 3). These discs, so punched into the exact form required, only need tempering to be at once fit for use. The holder of the disc-tool grasps it between (as it were) its finger and thumb with perfect firmness, and as the cutting rim projects only very slightly beyond the holder, it offers very little leverage to the resistance of the stone, and never gets loose or displaced. Either of these forms of tools may frequently be used for the same object, but each has its specific application as well.

I must now introduce you to another form of tool (Fig. 4), equally simple in its character with the last, but peculiar in its adaptation to a distinct purpose. It is formed out of a symmetrical, acute-angled trapezium, cut from a riband of steel, two or three sixteenths of an inch thick, according to the roughness of the work it has to do. To convert these slips of steel into the required form of tool, they are bent sharply on their middle, so as to bring the acute angles opposite to each other, but slightly turned out at their cutting angles.

FIG. 4.



These tools are cut from the ribands of steel without any waste, and if not left sufficiently sharp by the shears, a number of the flat slips are screwed up together in the vice, and sharpened by the file; they are then bent and hardened, and are fit for use.

The socket for this form of tool is extremely simple (Fig. 5); it is merely a hole into which the tool slips, and in which it is held by the spring of its own arms. The chief use of this tool will be the roughing down grindstones, and scarifying the rough surface of slate and stones, preparatory to the facing tool, and it is, perhaps, the best form of tool for under-cutting coal.

In addition to those already described, there are flat, concave, and other formed tools, all adapted to the holders, for giving ornamental and apparently hand-tooled surfaces to ashlers, quoins, sills, &c.; but as I shall have occasion presently to call further attention to them, when speaking of ornamental mouldings in machine-worked stone, I will not here dwell upon the subject.

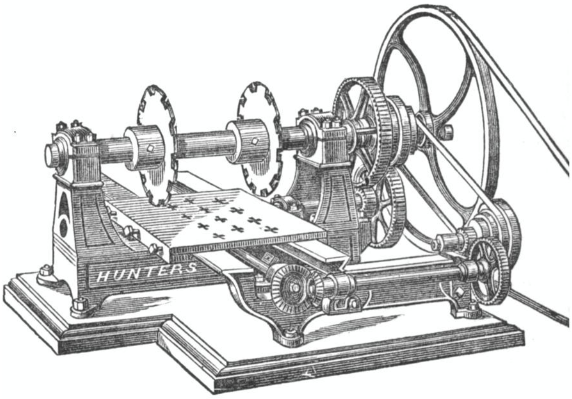
I now turn to the application of these simple, cheap, and effective weapons to various forms of machinery :—

First in order comes the "Hunter's saw."

The diagram attached (Fig 6) is so clear that it almost tells its own tale; it is taken from the small hand model upon the table. In the mechanism of the machine itself there is but little novelty, and it may be worked by any suitable power.

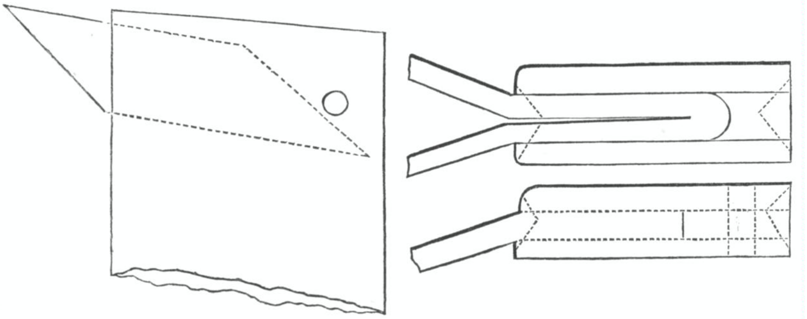
It consists of a table moving on V grooves, or on friction pulleys, to which the stone to be cut is fixed by cramps, or, when very massive and rough, as at Newcastle, by chains. The table is fed forward by a self-acting screw, and advances upon the cutting-blades at a speed of from three to six inches per minute; the speed varying with the work to be done and the nature of the stone. The cutting-blades, running from one to four in number, are fixed to collars, which traverse on an axle above the table, supported by uprights, and moved by a train of wheels in the usual manner. For adjusting the width, pinching screws in the collar of the cutters are slacked, and the blades are then pushed or worked by ratchet along the axle, and can thus be set apart to correspond with the width of any stone that the table can carry.

FIG. 6.



In Fig. 6, as well as in the foregoing description, the saw-blades are represented as working above the table, but they are not necessarily, or always so placed, except when the stone or slate to be cut into slabs or blocks is of variable widths, and the blades have to be moved on the axle to correspond therewith. When the blades are above the table the tools are made to cut up-

FIG. 5.



wards from below, by which the working of the machine is eased, as each tool slides smoothly at first into the groove formed by the preceding tool, and then cuts boldly out at the top of the slab in its own new path. But, when the blades are carried on an axle below the table, the cut must be from above downwards. If these arrangements are reversed, the tools will come *aplomb* on the stone with a jarring blow, and tend to drag it into the cutter, when the result may be the crumpling of the blade, or the stripping off of the tools from their holders.

Before leaving this machine I will state that, for cutting window-sills, door-posts, steps, coping-stones, and a host of other building materials, out of rough blocks of slate—which were formerly necessarily thrown away as useless, because there was no means of working them—we employ now three or four blades of four feet diameter, all cutting at the same time upon the same axle. These blocks, frequently twelve to sixteen inches thick, and weighing several tons, are simultaneously reduced to five thick slices, and immediately split up into the required thicknesses for planing, or tooling, as most suitable. An immense amount of paying work is thus turned out of rock, formerly all thrown away, and still accumulating by thousands of tons yearly on some of the giant and wasteful rubbish heaps of the Welsh slate quarries. At quarries in which I have a considerable interest there are now three, and will shortly be seven, saw-tables of large dimensions in busy and productive work—converting everything of value into slates, slabs, or building materials.

Under a recent improvement we use a succession of tables always advancing, on which the blocks are prepared before the saw is ready for them, which saves the time of running back the table, unloading, and preparing another block. Thus, so soon as the first cut is completed, the saw-blades are re-adjusted for the next block, the first table is brought on, and at once passes forward under a crane, where the block is re-adjusted for the next cuts, or, when finished, removed to be split up for the planes, and the table is either sent forward to the next saw with a fresh load, or lifted by the crane on to a line of rails parallel to the series of saws, and run back to commence its course again.

The next application of the movable cutting tools which I will describe differs but little in principle from the last, but is productive of very different results. The axle of the cutters is still above the table, but capable of being raised or lowered, as the cutting tools are in the ordinary engineer's plane. Instead of two or more blades fixed on their sliding collars, carrying an array of cutting tools on their peripheries, as in the saw, the axle itself, or a removable cylinder slipped on, or bolted in halves to the axle, receives the tools.

The object of the machine now under consideration is to give a finished surface to building or other stone of a more or less ornamental character; and breadth not depth has to be cut. The tools are fixed in holders, placed spirally round the axle or cylinder, so that a divided and regular pressure may come upon the face of the stone at intervals of two or three inches, always nearly uniform, but ever passing spirally from right to left. In the specimens of ashler shown, the tools formed one spiral, each fourth tool cutting at the same time, and six tools were entering into the cut as other six were leaving. A double spiral, in which the tools followed each other more closely in their cut, would have given more uniformity of strain, but could hardly have produced a more perfect piece of work. The fluting here produced may be varied without limit, or, the margin work cut by the flatting tool may be carried over the whole surface. By the introduction of a second cylinder, the beginning and end of each stone will receive a border across the stone corresponding to the long margin of whatever pattern it may be. For fluting or similar work the punched tools have a great advantage, whether of the disc or flat-faced form, as they are always of exactly the same diameter, and produce uniform work. The marginal tool may cut off a chamfer if required.

Anything that parallel working tools on a revolving axle can execute, will be done readily by this machine, and on a larger cylinder tools of a different shape may work along the same line so as to vary a running figure, by alternate markings. In fact, the outline of work thus produced seems unlimited, and ornamental figures, that this machinery cannot complete, may yet be prepared by it in outline ready for the sculptor's hand. Take the instance of a Gothic church window. The perpendiculars would be easily cut out in any running pattern, on a straight moving table, by a series of tools corresponding in their forms to the required surface. These tools would be fixed on a cylinder cast more or less in reverse of the same outline; but the same lines round the arch would render it necessary that the table carrying the stone should travel along rails or grooves, bent accurately to the curvilinear line required for each particular arch.

These hints will readily expand themselves in the mind of every practical man. Many figures more difficult than the above have already been considered, and the means of execution planned.

The roughing tool before described can be made to imitate the marks of a pickaxe in rustic stone work, with the usually chiseled work around it.

The table for carrying the stones to be faced in continuous lines has hitherto been supposed to be the same as that used for sawing or planing ordinary slabs, but when quoin or other stones of irregular dimensions and great size have to be treated, a distinct table, with a skeleton cradle, either movable or fixed, is necessary to receive the blocks, and offer the upper surface of the stone horizontally to the facing cylinder. The irregular-shaped block thus placed is fixed by pinching-screws or wedges, and the depth of cut is regulated by the lifting-tool gear as in a common plane.

Some of the patterns of flat tooling by these machines can be made to imitate chisel-work so closely as to be distinguishable alone by the finer finish given by the machine. The shortness and sharpness of the tool-cut are regulated by the diameter of the axle, the number of cutters, and the rate of feed. The finer kinds of limestones, including especially those of the Isle of Anglesea, receive almost a polish from the cutters. These machines will be of moderate weight except when required for the facing of massive blocks, and a very small power works them, so that they could be sent about the country to prepare the stones for a building on the spot, where an equivalent complement of masons could only be obtained by collecting them from great distances.

I will now describe the machines for cutting stone, &c., out of the living rock in the quarry itself. The principle here is, I believe, new. The cutting tools, instead of being placed in a single row around the rim of a thin blade, are fixed in rows of twos and threes alternately across the margin of a wheel-like disc, so as to clear away a wider space. The outer portion of this wheel-like disc is a ring of fine malleable cast-iron armed on the out-side with tools, and carrying a cog-wheel within. Not to enter into small details of fittings, this cogged wheel is made to revolve on a broad metal plate as its axle. This broad plate is of great strength, and forms four-fifths of the diameter of the entire cutter, and can be firmly bolted to the machinery frame by any part of its surface nearest to the cogged wheel which carries the tools, and the latter so held is made to revolve by a pinion around it. This arrangement allows eccentrically-held cutters to penetrate the rock to a depth exceeding the semi-diameter of the disc. In the circular saw with a central axle, the blade can only penetrate to so much of its semi-diameter as is clear of the axle and collar, and great force would be required to hold such a cutter up to its work in the rock, but in the machine now before us, the cutter-wheel is buried in the cut up to the point at which it is held, and practically allows of a cutter of 3 ft. 4in. diameter burying itself to the depth of 2 ft. 3 in., and as the cutter cuts out at a chord smaller than the diameter, the tendency of the outcoming tools is to draw the cutter into the cut, instead of forcing it out. A machine of this kind, cutting horizontally, works with great freedom, and advances rapidly through slate rock upon which it is employed. But when a cutting wheel on this principle is applied to make a vertical cut, a still smaller surface of the broad-axle plate is occupied by the holder, as it can in that position be grasped on both sides, and the axle, carrying the pinion, can be passed through the wheel and supported upon double bearings.

The machinery, including the cutter-wheel, for vertical cutting, is fixed on a carriage running upon rails, and worked by a wire rope. The cutter-wheel is gradually brought down from its travelling position by a worm and worm-wheel to press upon the rock till it buries itself up to the holder, when it is fed forward by a self-working screw, attached by chain and swivel to some point in advance, or by winding directly upon a chain.

A tolerable level having been first obtained on the face of the quarry, and a line of rails pinned down in the direction of the cut to be made across the greatest length, the machine commences its advance, leaving a deep groove behind it two or three inches wide, and two, three, or four feet deep. A series of parallel cuts may afterwards be made, or two disc cutters on the same carriage frame may be advantageously used to make two cuts at a time. An opening at the commencement of the first cut end must then be got out by blasting or otherwise, but afterwards, if the rock has any sort of cleavage, or layering, it may be wedged up from below. The rock from between the first two cuts being thus removed, the vertical cutter may readily be applied to cross-cut the longitudinal grooves into squared blocks, to be removed by under wedging, or partial undercutting, when there is not a favourable cleavage. The principle of the "under-cutting" machine is precisely the same as that of the vertical cutter. The cutter plate, however, has to be held horizontally by one side only. The cutter lies under the frame that carries it, and is advanced into its cut by worm-screw and worm-wheel as already described. When buried up to its holder in the rock, the cutter traverses along a slide frame twelve feet long; at the end of the twelve feet the slide and its carriage frame are pushed forward on the wheels for another length, and there fixed so as to leave the cutter free in its previous cut; it again proceeds on its journey, fed forward by its self-feeding screw, and so on to the end of the opening. The photographs of this machine exhibit all the details of its construction, which cannot be popularly explained without illustrations. The exposed parts of all these machines are very strong, and although shattered pieces of rock coming down upon the cutter-disc may momentarily impede its working, no injury to the machinery follows. The masses of stone cannot crush the disc, and the power employed in working the machine is not sufficient to break the wheel-work.

There are other applications of these movable cutters which I would gladly have introduced to the attention of the Society this evening, especially the coal-cutter, but the time allotted is too short for my venturing upon them on the present occasion. There are some photographs, however, which display the formidable character of the tunnelling machines. One form includes in its construction two parallel borers, cutting two tunnels each 5 ft. 4 in. in diameter, side by side, and freeing two cores weighing more than two tons each at every cut. The slab of slate, still marked at its ends by the cutting tools, indicates the size of the pieces of slate that may be won by it. From one core, and that one the first ever cut by that machine, 23 slabs of more than one ton in weight were made, besides a considerable number of slates. Its rate of progress in cutting is eight inches per hour, and the depth of cut allowed by the cutting-blades is twenty-one inches forward. This machine has penetrated many yards into the solid slate bed, and is destined, I fully believe, to revolutionise the present system of quarrying that valuable material.

Other photographs represent another form of the tunneller, which is now being erected in a quarry of the Ffestiniog Valley. It will cut a single tunnel six feet nine inches in diameter, and penetrate twenty-eight inches at each cut. The principle explained in the "under-cutting" machine is employed here, only the solid central holder, for the axle-plate, is here open in the centre as a ring, round which the cog-toothed cutter-ring revolves; and the latter, instead of carrying the movable tools on its periphery, in the same plane, carries three segment blades of steel, projecting forward, at the extremity of which a series of cutting tools are fixed, as in the saw-blades. The carriage of this machine is fixed in the tunnel immovably by bolt-screws, and the massive working parts gradually screw themselves forward as the cutters penetrate the rock. The open passage is preserved through the centre of the ring-frame and ring-cutter, to the front of the work, even whilst the machine is in action; owing to this, the core, after cleaving up, is more readily removed than from the double tunnelling machine. This machine will excavate more than five tons at a cut.

A high authority in engineering has lately condemned this principle of "planing" out a rim round a core as a mistake. I hope before the end of this month to prove, by a second marvellous success with a second machine, that practice is better than theory.

Five feet to 6 feet 9 inches will be no trifling advance in a second tunnelling machine; but a much larger diameter for mere tunnel driving will only facilitate its working, as it will admit of more space for strength. At all events, this machine admits of the greatest facility for replacing the tools, if blunted or worn by encountering hard matter in the rock. The feeding screw is simply run back, and the tools are examined and replaced without removing the framework from its fixed position. Generally the tools retain their sharpness throughout the cut. It must be remembered that these machines were made expressly for slate rock tunnelling, and have not yet been tried on sandstone or limestone rock for tunnelling purposes, which may offer fresh difficulties, only, I hope, to be mastered, and the usual means, perseverance and resolution, never fail us in this country.

The following are the dimensions and weights of parts of the great circular saw with thirteen-foot blades, now being erected near Newcastle for the Tyne Navigation Commissioners, by Mr. George Hunter:—Shaft, 15½ inches diameter; weight, 3 tons; driving-wheel, 3 tons; standards, 3 tons each; saw-blades with collars, 3 tons 2 cwt.; height above floor, 17 feet; cut, 5 feet 6 inches; width of cut, 1¾ inches; speed of tools, 18 feet per minute; feed of table for cut, 3 inches forward per minute; width between standards, 14 feet.

DISCUSSION.

Mr. BOTLY said they were very much indebted to Mr. Cooke for the very excellent paper to which they had listened, for to their Society anything which tended to economise labour and material must always be interesting. He had the pleasure of making a tour in North Wales in September last, when he had an opportunity of inspecting several of the slate quarries there. Some of these appeared, in his opinion, to be worked in a very slovenly manner. One thing he particularly noticed, which had been mentioned by Mr. Cooke, viz., the enormous waste of slate, especially in blasting. Large masses were wasted by the system of quarrying there adopted, and he apprehended, from the description of the machine, that a great saving might be made by its use.

Mr. R. G. LECKY had much pleasure in bearing his testimony to the value of the machines, having recently seen one at work. There were many points in it much to be admired, especially the facility for sharpening the tools, and the power of the saws to cut deeper than their semi-diameter, which was a great fault with common saws. He was able to speak to that point, because about 15 or 16 years ago he had helped to plan, construct, and erect, what he believed was the largest slate saw ever made up to that time. It was for the Valentia quarries, and was capable of cutting nine inches of Valentia slate, which was pretty hard. Working with two 3 ft. 6 in. saws on one axle, they were able to cut nine-inch slabs at the rate of about five feet an hour, and this was considered pretty good work. He thought, therefore, that Mr. Cooke had spoken a little too depreciatingly of the working of toothed saws. These saws certainly lasted a very long time, for one pair had been at work for six months or more, and only required sharpening once a day. The blades were $\frac{1}{4}$ inch thick, and there was one-eighth set on each side, so that the breadth of the cut was half an inch. It was much easier to work these two saws than to work a single-bladed hand-saw. He believed these saws were still at work at Valentia. Hunter's saw, however, was a most efficient machine, and he was very much pleased with it.

Mr. C. F. Varley said that about two years ago he paid a visit to the neighbourhood which Mr. Cooke had described, and he had spent a considerable time in the quarries known as Lord Palmerston's, which he believed yielded the best slates to be found in that part of the world. The first thing which struck him was the mountains—not merely hills—of waste. It was something prodigious; in fact, he believed he was correct in saying that only about one-ninth of the slate got out of the quarry was ever brought into the market in the form of slabs or roofing slates, and that under the most favourable circumstances, when they had obtained large and sound blocks, they never succeeded in making more than one-fourth of the material so extracted available for commercial purposes. The process of tunnelling, which Mr. Cooke had particularly alluded to, seemed a very important one. It was necessary to form tunnels through the slate to get from section to section, and as in so doing they undercut the mountain, it was requisite to leave strong pillars to support the superincumbent portion, and all this had to be done before getting at the slate. It was therefore evident that if this tunnel took such an enormous time to cut—Mr. Cooke had mentioned ten yards a month—there must be a large amount of capital lying idle in such a quarry for a considerable time before any returns were made. Anything, therefore, which would quicken these preliminary operations must be very valuable, and he understood from Mr. Cooke that the tunnelling machine would do the work three-and-a-half or four times as quickly as it could be done by the old method. The combination of the circular cutter and the under cutter, by which pieces of slate were brought out ready for immediate working, seemed also very valuable, and he had been informed that in this way rather more than one-half of the whole amount of slate taken from the quarry had been actually rendered available for the market. That alone showed the immense value of the machines which Messrs. Hunter and Cooke had already brought into successful operation. The photographs which were exhibited showed that several little difficulties which had presented themselves when he was in the neighbourhood had since been mastered, and he saw no reason why the machines should not meet with all the success which had been hoped for them, especially since the cutters could be made in so simple a manner, so rapidly, and at so trifling a cost. These little circular discs were nearly the only parts of the machine which underwent any serious wear and tear, and these were stamped out so quickly that the only parts of the machine likely to wear—the teeth of the saw—were rendered the cheapest to construct, and not only this, but they were so simply and easily taken out and replaced that it took only about ten seconds to remove a damaged one and substitute a new one, the cost being, he should imagine, a very small fraction of a penny. All this, too, could be done without withdrawing the machine from its work. That he considered one of the greatest improvements. The application of the cutting machinery to the working of the stone seemed, however, to his mind, even more important than that which he had referred to, the mere cutting out of the plate, as it superseded the necessity for the enormous amount of hand-labour now employed in cutting and dressing stone. There was another point of view also from which it seemed to him that the invention ought to receive the especial approval of the Society. For many years, especially under the presidency of the Prince Consort, great attention had been paid to improvements in buildings for the poorer classes, and also to familiarising the public eye with articles of artistic design. One of the specimens on the table, to which Mr. Cooke had not drawn attention, was a piece of a ridge-tile, or stone, and in that it would be seen that, simply by one tooth of the machine being placed rather more prominent than the others, an effect very similar to what was called engine-turning had been produced, an effect which could not be produced by hand except at an immense cost. In the same way, it was evident that, by slightly varying the position of the tools, almost any design or moulding in stone might be produced. He believed that Mr. Cooke had done for stone that which was done many years ago for wood, and that material which before was of small value, but of costly manufacture, was now easy to be worked, and would, therefore, be produced in great abundance and at low cost; so that stone would begin to take the place of brick in very many instances.

Mr. Cooke, in reply to the questions and observations which had been addressed to him, said he feared the great waste from blasting would never be diminished in some of the great quarries. The floors were not so deep, however, as had been imagined; the deepest, with very few exceptions, were about 60 feet. In one or two instances, perhaps, the depth might be 90 feet. The practice which had been adopted there for some time was to bore a hole 14 or 15 feet in depth and 2 inches or $2\frac{1}{2}$ inches in diameter, and charge it with powder, explosive glycerine, or cotton, and so bring down an enormous mass of slate, which, perhaps, would take three months in removing. He had seen, at Mr. Assheton Smith's quarry, a mass of slate which had not been entirely removed at a second visit, four months later. With such a quantity falling such a height, of course an immense amount was damaged, and not more than one-ninth, or sometimes a tenth, was fit for the market. He believed the proprietors would do well to introduce these machines, and thus effect a great saving. They had sometimes sent him pieces to cut, and a short time since he received a block of about four tons, which he returned in about half-an-hour, cut into fine slabs. Nothing could have been made of it without the machine, as some parts were very hard, and there was no good cleavage. He was afraid, however, that the wasteful system would continue for some time in the large quarries, where the owners, being wealthy men, looked for a large and rapid return, although such a mode of procedure must tend to exhaust the material; and he believed that one quarry at Penrhyn was already causing the proprietor some anxiety. He had been much interested in hearing from Mr. Lecky of the Valentia saw, which was new to him, or he should certainly have referred to it in the paper. He would like to know the speed at which it worked. The ordinary speed of their small saws was 120 ft. to 130 ft. a minute.

Mr. Lecky said the Valentia saw was driven at a speed of nine revolutions a minute, or about 108 ft.

Mr. Cooke said that their machines worked at only 45 ft. per minute. He believed the Valentia stone was very valuable, but that it was not a slate, and had no cleavage, being only valuable for slabs, and not for roofing slates.

Mr. **LECKY** said the stone was a true slate, and had a decided cleavage, though the softer portions would only cleave into very thick roofing-slates. The slabs were cut with hand-saws.

Mr. **COOKE** said that appeared to be a slate which wore the saws very little, for at the Ffestiniog quarries he had seen a saw removed twice in a day to be sharpened, and had known one worn out in the course of a fortnight. The work done by the Valentia saws was very good, and although there would be more waste, the comparative cost of the machinery at starting would, probably, in that instance, be in favour of the saws. He considered the small disc tool a perfect masterpiece, and the cost of each would certainly be a small fraction of a farthing. The ornamental work to which Mr. Varley had called attention arose from an accident; one of the tools being rather larger than the others, every time it came round it made one of those curves. Of course no one could see that without seeing that the same thing might be turned to advantage, and there was no doubt that the tools could be so arranged as to produce on the stone every effect of engine turning.

Mr. **BLACKIE** observed that the cost of the machines had not been stated, or the cost of erecting them, and what was the percentage of wear and tear, which, he imagined, must be considerable. He should also like to know what power was used to drive them, and the amount of horse-power required for a large machine.

Mr. **COOKE** said that, in the case of one of the machines which had been in operation two or three years, it had not yet shown any symptoms of wear and tear; it was difficult to form a calculation, but the part which seemed to wear most was the nut which worked the feed-screw; the dirt got in there and wore away the brass. The cost of the machines varied from £100 to £1,500; those were the two limits.

Mr. **BLACKIE** suggested that if cups were applied over the bearings and parts where dust was likely to fall, it would save wear, and remarked that no information was given as to the temper of the tools, and whether water or any other liquid was used in cutting the stone. It appeared to him that, whatever might be the temper of the tools, if they were worked dry, the friction and consequent heat would be so great as very quickly to destroy them.

Mr. **COOKE** said the machines worked so slowly that unless when cutting something particularly hard, like quartz or iron pyrites, the tools did not heat in the slightest degree. On one occasion, in cutting through some iron pyrites, he had found the tools not only hot but actually melting. Such cases were very exceptional, and must be dealt with when they occurred. With the circular form of tool, it was easily turned round with the finger as it came up, so as to present a fresh edge, and each tool gave them three cuts before it was worn out, and the largest of these tools would not cost certainly more than a farthing. There was a great difference of opinion amongst the workmen in Wales as to the merits of dry or wet cutting; in some quarries, where there were a great many circular saws at work, the men liked to use water, and in others they did not. In his (Mr. Cooke's) quarries they invariably used water in tunnelling, both to keep the tools cool and to wash out the *débris*. They worked the double-tunnelling machine with a small turbine, and some of the water, before it reached the turbine, was sent through a tube into the cutting, so that the tools were kept quite cool, and he had seen them go in for a second cut without turning, and that in bad slate, where there was a good deal of iron pyrites. With regard to the temper, he had already mentioned that it varied according to the stone to be cut. They did not send slate tools to Newcastle to cut limestone; a very inferior tool would do for that work. Nothing was worse to cut than sandstone or slate. The sandstone yielded too soon and ground the tool, and the slate also would always grind it. It would take a considerable time to grind the hard edge of the tool off, but when that was gone it was soon finished. Only the day before a mason had been looking at the various specimens of work on the table, and he at once observed that a different tool would be required for each. Marble would very soon destroy the edge of a tool if used dry, but if abundance of water were used nothing cut more easily, and a fine polish was left; it was like turning brass with oil, or iron with water, if they were turned dry the tool would very soon be spoiled.

Mr. **BLACKIE** suggested that the powdered stone which resulted from the cutting would be valuable for mixing with lime, in parts of the country where sand was not easily obtainable.

Mr. **COOKE** said this was a very good suggestion.

The **CHAIRMAN** then moved that a cordial vote of thanks be given to Mr. Cooke for the paper which he had brought before them. The machinery he had described seemed likely to prevent the waste of material of considerable value, and was certainly most ingenious.

The vote of thanks was then passed.

Mr. Cooke illustrated the action of his machinery by a working model, and a large number of specimens, showing the effect of the various tools described in his paper.

THE ROYAL COMMISSION ON RAILWAYS.

The Royal commissioners on railways have at length made their report, which sums up in great detail the results arrived at from the mass of evidence adduced before the commission, and gives judgment against the proposition that the railway system should be taken under the control of the state. The general conclusion of the commissioners is, in short, that no comprehensive plan shall be undertaken, and that the dealing with the railway system shall be confined to private-bill legislation and in the management by companies. The report says:—

"We are of opinion that it is inexpedient at present to subvert the policy which has hitherto been adopted of leaving the construction and management of railways to the free enterprise of the people, under such conditions as parliament may think fit to impose for the general welfare of the public.

"We consider that there is not sufficient reason for excepting Ireland from this general conclusion; but, as it has always been the established policy to assist railways and other public works in Ireland, we recommend that, when parliament thinks fit to make advances to Irish railway companies, the money should be lent for a fixed period of considerable length, so as to enable the company to develop its resources before it is called on for repayment. We are, however, of opinion, that advances should not be made to the Irish railway companies as a condition of reducing their rates and fares; but that, as the railway companies have the best opportunities of judging whether rates can be reduced so as to be recuperative within a reasonable time, they should be left to carry out such experiments at their own risk.

"We recommend that parliament should relieve itself from all interference with the incorporation and the financial affairs of railway companies, leaving such matters to be dealt with under the Joint-stock Companies Act, and should limit its own action to regulating the construction of the line and the relations between the public and joint-stock companies so incorporated, requiring such guarantee as may be necessary for the purpose of securing the due performance of the conditions upon the faith of which the parliamentary powers of the company have been granted.

"We do not consider that it would be expedient, even if it were practicable, to adopt any legislation which would abolish the freedom railway companies enjoy of charging what sum they deem expedient within their maximum rates, when properly defined, limited as that freedom is by the conditions of the Traffic Act; but we are of opinion that railway companies should be required to give a reasonable notice of their intention to raise their rates of charge.

"We are unable to see any method of ensuring punctuality in passenger trains by means of legislative enactments, except that proposed by the committee of the House of Commons in 1858—viz., that punctuality should be guaranteed, and that passengers injured by delay should be enabled to recover summarily a fixed sum; but we have already referred to the objections to this proposal.

"We are of opinion that railway companies should be bound, under adequate penalties, to give at least a week's notice of any alterations of time of their regular passenger trains.

"We do not consider that any direct legislative enactments would cause greater economy in the working of railways; but we are of opinion that, with the object of affording a more accurate view of the operations of the railway companies, and of making any undue extravagance apparent, and thus stimulating economy, it is desirable that the several railway companies should render their accounts to the Board of Trade, showing receipts from traffic and the detailed cost of working the line, upon a uniform plan; and that, after consultation with the railway companies, the Board of Trade should not only prescribe the form of such returns and accounts, but lay down the basis on which they are to be computed.

"Parliament has relied, for the safe working of railways, upon the efficiency of the common law and of Lord Campbell's Act, which give persons injured, and near relatives of persons killed, a right to compensation. We consider that this course has been more conducive to the protection of the public than if the Board had been empowered to interfere in the detailed arrangements for working the traffic."

Fine Arts.

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EXHIBITION IN PARIS OF THE PRODUCTS OF THE PUBLIC SCHOOLS OF ART.—The Minister of Public Instruction has determined upon establishing a general exhibition of works of art of all kinds produced in the Art Schools of the State, and has devoted the terrace of his mansion to the purpose. Three galleries, which will be finished in a few days, will be appropriated as follows:—In one will be specimens of modelling, architectural works, casts in plaster, plans, linear drawings, ornaments, stereotomic models, and mathematical and philosophical instruments. The central gallery will be devoted to drawings, engravings, lithographs, and photography; and in the centre will be an exhibition of needle-work, lace making, application, embroidery, and other works produced by the pupils of the female schools. The third gallery is intended for a different purpose, namely, the exhibition of objects of value and interest, brought from Mexico by the Scientific Mission, with a systematic collection of ores and minerals made in Mexico, and a number of statuettes of divinities of past times, and other works of art.

Manufactures.

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CENTRIFUGAL GUN.—Dr. Steinheil, Professor of Natural Philosophy at the University of Munich, well known in the scientific world for having laid down an electric telegraph at a very early date, has invented a gun, which is thus described by one of the *Times'* correspondents:—"Figure to yourself an iron plate of a circular shape, sunk in the middle. This cavity is filled with balls, which, on the plate being set in motion, are propelled along a groove radiating to the edge, where they are received into one or several barrels made to point to the object aimed at. The centrifugal force with which they leave the disc, being on mathematical principles 12 times as great as the celerity attained by the revolving edge, exceeds, we are confidently assured, anything yet achieved by rifles. The disc, which has a close-fitting covering and several other addenda, to facilitate the surer aim, is set in motion by a wheel, worked either by a single man, or, in the case of heavier balls, by a steam-engine. This novel catapult—which, it may have struck the reader, is constructed upon the same principle of centrifugal force active in man's oldest projectile, the sling—may, it is asserted, be made to hurl from 60 to several hundred balls towards one point in a minute. The first specimen of his gun was submitted by Dr. Steinheil to the inspection of the Bavarian War-office as early as 1832. Sixteen years later he produced another and heavier machine of the same sort, throwing grape, and requiring a steam-engine to work it. In both instances the Bavarian War-office passed a favourable opinion upon the cannon, but did not think it adapted for other purposes than the defence of fortresses and ships. The secret of the invention then transpiring, the machine appears to have been imitated in several quarters, and also got to America, whence it reached the Emperor Napoleon. In Germany the Brothers Eberhardt, at Ulm, have just turned out an offensive weapon, operating, it would seem, on the same principle, but having four barrels instead of one, as is the case with the French "infantry cannon." Each barrel is stated to be capable of 60 discharges in a minute. Should all this be confirmed by the experiments sure to be made in more than one place, it is, perhaps, not too sanguine to entertain a hope that war will become more and more rare, owing to the dreadful perfection of the instruments intended to further it."

Commerce.

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PROGRESS OF FRENCH COMMERCE.—A work has been published by M. Devinck, formerly President of the Tribunal of Commerce, at Paris, containing an inquiry into the progress of commerce and manufactures in France. From this it appears that in 1851 the commercial and manufacturing situation of France was as follows:—Imports, 1,094 million francs; exports, 1,520 millions, making a total of 2,614 million francs. In 1865 the imports were 3,528 millions, and the exports 4,087 millions, or, in all, 7,615. In 1866, for the first eleven months only (the general balance not having been yet established) there is a total of about 8,500 francs, being an increase in fifteen years of nearly 200 per cent. In 1851 the number of French vessels which entered or left the French ports was 34,436. In 1865 the figures rose to 51,156, showing for maritime commerce alone a progress of about 50 per cent. In 1851 the network of railways measured 3,500 kilometers (five-eighths of a mile each), but at the end of the year 1866 it showed a length of 14,000 kilometers actually at work. The concessions form a much larger amount—more, in fact, than 21,000 kilometers. In 1851 the telegraphic service possessed 100 stations for 3,000 kilometers, and transmitted 10,000 despatches. In 1866 it was in operation for a distance of 31,500 kilometers, possessed 2,100 stations, and transmitted 2,500,000 despatches. The charge has been reduced by 70 per cent. since 1851. The number of letters carried in the earlier period was 65,000,000, whereas in 1865 it had risen to 329,000,000. The postage has been diminished on an average one-fifth, and the conveyance has become four times more rapid. In 1851 the amount of discounts at the Bank of France was 1,241 millions, whereas in 1866 it was 6,574 millions. During the same period the produce of the coal-basins has been increased two-fold, and that of the manufactures in cast and wrought iron tripled. The state has executed great works for improving the navigation of canals and rivers. By buying up the tolls paid to companies the tariffs have everywhere been either suppressed or lowered. In the year 1851 the indirect taxes and those on consumption produced a sum of 738,242,000 frs.; in 1852, 804,334,000 francs; and 1866, 1,282,268,000 francs. At the same time that the consumption has been so prodigiously developed to the great profit of the Treasury, the public savings have been most considerable. In fifteen years France has furnished capital, the amount of which may be set down at 20,000 millions, which has been either invested in loans contracted by different governments, or employed in the establishment of railways, formation of powerful companies, or in great works of public utility, and in material improvements of every kind.

Colonies.

INTERCOLONIAL CUSTOMS DUTIES.—A Queensland paper, referring to the impediments caused to trade by the existence of border custom-houses, says:—"There ought to be no necessity for any thing of the sort between the different Australian colonies, and it may be avoided by a mutual recognition by the various governments of what is just and equitable to each other. The increase of traffic across the different borders as population increases will eventually bring about the first step towards federation in the establishment of one uniform system of customs duties, the proceeds being equitably divided between the colonies. In the meantime it is the duty of each of them to make such temporary arrangements as shall give substantial justice without interfering with the freedom of trade."

Publications Issued.

MODERN MARINE ENGINEERING APPLIED TO PADDLE AND SCREW PROPULSION. By N. P. Burgh, Engineer. (*E. and F. H. Spon.*) This work treats of ordinary, compound, and expansive engines, adapted for paddle, single, and twin screw propulsion; of surface and injection condensers; of expansion, equilibrium, slide and other valves; of link motion, starting gear, thrust blocks, paddle wheels, screw propellers, ordinary and super-heating high and low boilers, and other subjects connected with marine engineering. It contains 36 coloured plates, 259 practical illustrations, and 403 pages of letter-press, the whole being an exposition of the present practices of the following leading firms:—Messrs. J. Penn and Son, Messrs. Maudslay, Sons, and Field, Messrs. James Watt and Co., Messrs. J. and G. Rennie, Messrs. R. Napier and Sons, Messrs. J. and W. Dudgeon, Messrs. Ravenhill and Hodgson, Messrs. Humphreys and Tennant, Mr. J. F. Spencer, and Messrs. Forrester and Co. Mr. Burgh is also author of "A Treatise on Sugar Machinery," "Practical Illustrations of Land and Marine Engines," "A Pocket Book of Practical Rules for Designing Land and Marine Engines, Boilers, &c.," "The Slide Valve Practically Considered," "The Manufacture of Sugar, and the Machinery Employed for Home and Colonial Purposes," &c.

Notes.

POST-OFFICE ALTERATIONS.—The Postmaster-General has issued announcements of several alterations with respect to foreign mails. One is to the effect that the limit in weight of books and patterns sent to the East Indies has been raised from 3lbs. to 5lbs. Another states that, as the Peninsular and Oriental Steam Navigation Company are about to withdraw the extra steam vessels which they have appointed experimentally to sail from Suez to Bombay simultaneously with the packets which leave Suez about the 5th and 20th of each month for Madras and Calcutta, the last extra mail from London to Bombay will be forwarded from London on the 20th May, *viâ* Southampton, and on the 27th May, *viâ* Marseilles; and thence forward, and until further notice, correspondence addressed to the East Indies will be despatched as it was despatched previous to January 20th last. It is also stated that the postal commission has been re-established between Vienna and Constantinople, by way of the Danube and the Black Sea. Advantage will be taken of a line of railway which has just been opened between Rutschuk and Varna. Mails for conveyance by this route are despatched from Vienna on Mondays and Fridays, and letters from the United Kingdom will be in time for the mail of Monday if despatched from London *viâ* Ostend, on the morning of the previous Saturday, and for the mail of Friday if despatched from London on the morning of the previous Wednessday. Letters from Constantinople, which the senders may desire to forward by this route, must be specially addressed "*viâ* Ostend. The postage will be 9d. for a letter not exceeding half-an-ounce in weight when pre-paid, and 11d. if sent unpaid.

LITERARY CONGRESS IN PARIS.—La Sociêté des Gens de Lettres has decided to hold an international congress during the present exhibition season, in order to give literature all the advantage that may be derived from the presence of foreign writers in Paris; these will be invited to attend the meetings and debates of the society, the dates of which will shortly be published. The society considers that now that barriers are disappearing, and distances are almost effaced by mechanical means, literary questions increase in importance and interest to all the world instead of merely to the nations in which they arise. Travelling, translation, and the increasing study of foreign languages are tending to make literary productions universal property, which all are called to watch over and diffuse. Lastly, the hope is expressed that such a congress may lead to the establishment, in other countries, of societies of men of letters similar to those which render valuable service to French writers.

CONCENTRATED MILK.—The *Estafette* of Lausanne says that the business in concentrated milk at Cham, near Zoug, promises to become of importance. The method employed is thus described: the milk is placed in an apparatus where the aqueous portion is withdrawn by a kind of air pump; a certain quantity of sugar is then added, and when the milk is of the consistency of thick honey, it is placed in tin boxes and hermetically sealed. One litre of the concentrated milk is said to be equal to more than four litres of fresh milk.

A GLASS HOUSE.—A large building, five stories high, to be used as a factory, is being erected in the Rue de Tardy, at Saint Etienne, which attracts great attention. With the exception of the back wall, the whole façade is of glass; in fact, the three sides consist of iron frames supported by stone columns, and filled in with sheets of thick glass.

To Correspondents.

ERRATA.—In the last number of the *Journal*, p. 403, col. 2, last line, for "59," read "65;" p. 404, col. 1, line 2, for "56," read "69;" col. 2, line 18, for "400," read "360;" p. 405, col. 2, line 58, for "74," read "745;" at p. 406, col. 2, line 62, for "quantity," read "quality."

MEETINGS FOR THE ENSUING WEEK.

MON......Society of Arts, 8. Cantor Lecture. Mr. Chaffers, "On Pottery and Porcelain."
R. United Service Inst., 8½. Commander Pownall W. Pellew, R.N., "Fleet Manœuvering."
British Architects, 8.
Asiatic, 3. Annual Meeting.

TUES ...Civil Engineers, 8. 1. Renewed discussion upon Mr. Chance's paper, "On Optical Apparatus used in Lighthouses." 2. Mr. Edward Byrne, "Experiments on the Removal of Organic and Inorganic Substances in Water."
Statistical, 8. Mr. J. T. Hammick, "On the Judicial Statistics of England and Wales."
Pathological, 8.
Ethnological, 4. Annual Meeting.
Royal Inst., 3. Prof. Miller, "On Spectrum Analysis."
R. Horticultural, 3. General Meeting.
WED ...Geological, 8. 1. Capt. Spratt, R.N., "On the Bone Caves of Malta." 2. Mr. R. Tate, "On the Lias of the North-east of Ireland." 3. Mr. R. Tate, "On the Fossiliferous Development of the Zone of *Ammonites angulatus* in Great Britain." 4. Mr. F. M. Burton, "On the Rhætic Beds near Gainsborough."
R. Society of Literature, 4½.
Archæological Assoc., 8½.
THUR ...London Inst., 7. Prof. Bentley, "On Botany."
Zoological, 8½.
Mathematical, 8.
Royal Inst., 3. Prof. Huxley, "On Ethnology."
Royal, 8½.
Antiquaries, 8½.
FRI ......Linnæan, 3. Annual Meeting.
Royal Inst., 3. Prof. Herschel, "Falling Stars of 1866-7."
SAT ......Royal Inst., 3. Prof. Huxley, "On Ethnology."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. Numb. *Delivered on 8th May, 1867.*

129. Bill—Metropolis Gas (amended).
135. ,, British Spirits.
176. National Gallery—Return.
245. Poor Rates and Pauperism (Ireland)—Return.
249. British Museum—Accounts.
Public Petitions—Twentieth Report.

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442. (A X.) Poor Rates and Pauperism—Return (A).

Delivered on 9th May, 1867.

118. Bill—Labouring Classes Dwellings Acts (1866) Amendment.
248. Sea Fishery (Scotland and Ireland)—Return.
254. Population (Staffordshire)—Return.
268. Metropolitan Local Government, &c.—Second Report.

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251. (III.) East India (Military Finance, &c.)—Memorandum.

Delivered on 10th May, 1867.

136. Bill—Parliamentary Registration.
138. ,, Execution of Deeds (amended).
139. ,, Metropolis Subways.
217. Reformatory and Industrial Schools—Return.
237. William O'Brien and Bartholomew Keily—Reports.
250. Turnpike Trusts (Devizes)—Memorials.
269. New Palace (Westminster)—Correspondence.

Delivered on 11th May, 1867.

241. Chain Cables and Anchors—Correspondence.
270. East India (Army)—Instructions.
281. Sugar and Molasses—Return.
Public Petitions—Twenty-first Report.

Delivered on 13th May, 1867.

140. Bill—Bridges (Ireland) (amended).
142. ,, Brown's Charity.
143. ,, Tancred's Charity.
144. ,, Sir J. Port's Charity.
194. Public Income and Expenditure—Account (31st March, 1867) (corrected copy).
275. New Boroughs—Return.
283. West Indies—Papers.
282. West India Colonies—Return.

Delivered on 14th May, 1867.

140. Bill—Bridges (Ireland) (amended) (corrected copy).
141. ,, Banns of Matrimony.
183. Jamaica—Proceedings of the Courts Martial.
253. Police and Improvement (Scotland) Act—Returns.
276. Vaccination—Memorial.
278. Seamen's Savings Bank—Account.
280. Merchant Seamen's Fund—Account.
Ordnance Survey and Topographical Depôt—Report.

SESSION 1866.

442. (D.) Poor Rates and Pauperism—Return (D).

Patents.

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From Commissioners of Patents' Journal, May 10th.

GRANTS OF PROVISIONAL PROTECTION.

Agricultural implements—3436—W. Exall.
Agricultural implements—1168—W. E. Gedge.
Awnings, &c.—503—H. J. Cole and W. C. Horton.
Axles—1156—S. Cocker.
Bale fastener—1162—H. Fassmann.
Bottles, feeding—1010—W. C. Webber.
Charcoal, peat—1190—J. H. Johnson.
Cutlery—1196—W. R. Lake.
Devices, &c.—184—W. P. and G. Phillips and D. Pearce.
Enamel—1118—J. Oakden and J. Pickin.
Fibrous materials, opening—1019—W. Tatham and W. T. Heap.
Gas, &c., measuring—1158—R. H. Frith.
Glues, &c., keeping warm—1208—T. Booth.
Hat guards—1154—L. Davis.
Hoes, horse—1184—W. F. Wilkinson.
Hooks, tackle—1202—A. M. Clark.
Lamps—1166—D. Fryer.
Mash tuns—1150—J. Millward.
Meat, &c., preserving—1200—C. E. Brooman.
Motive power, economising—973—H. A. Bonneville.
Motive-power engines—1164—J. Peebles.
Paper, &c., coating—659—W. R. Lake.
Petroleum, &c., burning—1180—S. J. Mackie.
Ploughs—1094—H. B. De Beaumont.
Pulverizing apparatus—1206—C. D. Abel.
Railways—851—M. Holland.
Refrigerators—787—F. Gregory.
Roadways, &c., construction of—1018—H. Buss.
Rudders, hanging—956—H. A. Bonneville.
Sewing machines 1186—L. B. Bruen.
Sugar machines—1178—W. R. Lake.
Tools, machine—334—S. Alley.
Turnips, &c., preparing—1204—H. Smith.
Turrets, &c.—1176—J. Westwood.
Vapour apparatus—1188—C. F. Whateley.
Weights, raising—990—J. Pickering.
Wheels—1160—J. Atkinson.
Wools, &c., destroying vegetable matters in—1198—C. E. Brooman.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

Binders for papers, &c.—1313—N. M. Shafer.
Boots, &c.—1256—W. Snell.
Steam engines—1351—N. W. Wheeler.
Valves—1306—J. Thèvenet.
Valves—1348—N. W. Wheeler.
Valves—1350—N. W. Wheeler.
Ventilators, &c.—1349—N. W. Wheeler.
Yarns—1340—A. H. Gilman.

PATENTS SEALED.

2953. J. Ingram and H. Stapfer.
2959. J. R. Cadman.
2972. W. Clark.
2983. T. S. Truss.
2985. H. Hughes.
2986. T. Page.
2995. J. Nichols.
2996. E. C. Hodges.
2997. L. Bernieri.
3002. W. Grüne.
3013. J. W. Hurst.
3020. I. Evans.
3023. W. E. Gedge.
3024. J. H. A. Gruson.
3047. C. E. Brooman.
3056. W. Clark.
3072. C. E. Brooman.
3164. W. Butler and A. Dalgety.
3282. W. R. Lake.
207. J. Nodder.
229. W. Snell.
520. W. H. Samson.
710. J. A. Fussell.

From Commissioners of Patents' Journal, May 14th.

PATENTS SEALED.

3007. J. H. Johnson.
3012. J. M. Dunlop & F. Crossley.
3016. J. Bolvin.
3018. D. Kirkaldy.
3026. E. W. Morton.
3028. T. Earp and R. Ashton.
3030. A. P. Price.
3031. T. Wardlaw.
3033. J. H. A. Gruson.
3035. J. H. A. Gruson.
3036. W. A. Gibbs.
3037. T. Whitley.
3038. J. L. Clark.
3043. G. Haseltine.
3048. J. Robertson.
3049. J. H. A. Gruson.
3051. J. H. A. Gruson.
3061. P. G. B. Westmacott.
3063. P. Gledhill.
3074. G. F. and J. Stidolph and J. R. Morley.
3079. W. H. P. Gore & R. Green.
3112. N. S. Shaler.
3134. G. Haseltine.
3157. W. Crighton.
3163. J. Pratt.
3186. G. Haseltine.
3189. W. H. Richardson.
3190. E. L. Paraire.
3238. F. C. Buisson.
3311. H. Hall.
215. E. Bellard.
231. J. Greenshields.
649. B. Snow.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

1148. W. Hirst.
1158. J. Wavish.
1180. T. W. and R. Condron and G. R. Hartshorne.
1210. R. F. Fairlie.
1244. G. Hunter.
1196. T. M. Gisborne.
1198. R. Wilson.
1205. T. N. Kirkham and V. F. Ensom.
1242. J. Hamilton.
1644. E. T. S. L. McGwire.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

1128. J. D. Dougall.
1178. J. Chatterton & W. Smith.
1393. J. Saunders and J. Piper.
1182. E. Lord.